1. Research Questions:

A key problem in the academic field of dance is how to capture and document the incremental development of ideas and their material manifestation in the creative process within practice-led research. In improvisational, embodied investigation, the mode of engagement is generative, pre-verbal, intuitive, experiential and fluid. This militates against types of cognitive engagement necessary for analysis, critique and reflection. The problem is most acute in the context of dance: however it is pertinent to all arts-based disciplines. This project is predicated on dialogic processes between dance and e-Science and the fluidity of concepts as they transverse the two domains, making use of recent advances in the visualisation and representation of spatio-temporal structures and discourse. Two intersecting key research questions are central to the project:

- What unique opportunities does the distributed Access Grid environment provide for developing new approaches to choreographic composition and process and within this context how can we find new, appropriate and meaningful methodologies for capturing and modelling practice-led research?

- How can choreographic knowledge and sensibility help to shape e-Science practice to make its applications more usable within the field of performance arts practice-led research as well as the broader Arts and Humanities context?

The first key question addresses new creative possibilities provided by this distributed, collaborative environment, with multiple sites of performance and spectatorship. How might this redefine choreographic understandings of embodied spatio-temporal relationships? The Access Grid (AG) problematizes existing discreet understandings, blurring the boundaries between: live dance, pre-recorded screen-based dance, telematics, and hybrid integrations of live and projected dance material. Significantly, dance applies an aesthetic frame to the Grid, therefore the interface that literally frames the content and exchange between participants needs further consideration and design in order to offer flexible usage for arts practice.

We will explore notions of interactivity in the distributed context, in particular, whether existing tracking software can be incorporated into the AG environment to mediate live streamed video material. The multi-perspective nature of the environment throws into question the position of the choreographer's authorial voice as arbiter. When working in a distributed yet collaborative environment how can participants take account of the paradoxical subjective position of being alone/separate, yet together?

The project examines how Grid-based hypermedia and semantic annotation tools might support, enhance and document creative processes. It is envisaged that these tools will be deployed as a means of capturing and rendering visual, the discursive/dialogic practices inherent in the

choreographic process, whether that be participants' internal dialogue or discursive practices between choreographer and performer. The visual nature of the interface employed by these e-Science documentation tools enables exploration of possibilities for pre-linguistic, multi-layered, non-linear representations of process, more aligned with the characteristics of the creative process itself. This reiteration of process will be considered not just as a static archival document of the process, but as a dynamic source of material that can be redeployed, for example, as a site for forensic, archaeological investigation; a score for further developmental commentaries generated through practice; or pre-recorded audio/visual content for re-use in hybrid distributed performance.

The second key question focuses on how choreographic knowledge can shape e-Science thinking and practice. In practice-led research, experiential knowledge is emphasised as a central epistemological frame. The embodied nature of the activity implies a pre-requisite level of physical skill with attendant features such as an enhanced sense of proprioception and heightened awareness of corporeality. These attributes have considerable significance for recent developments towards the notion of "experience design" as a means of improving the interaction design of e-Science technologies. The nexus of embodied, compositional understandings of spatio-temporal structure enables further consideration of concept-mapping practices and the visualization of spatio-temporal distributions of information and ideas, challenges currently concerning the project's e-Scientists. Common to both disciplines is an interest in the making and marking of spaces: conceptual, narrative, virtual, embodied. The reciprocal impact of the two disciplines in developing new understandings of space and the subjective experience of space are fundamental to this proposed investigation. Can the project build new trans-disciplinary understandings and applications of spatio-temporal concepts such as narrative, trace, and memory?

2. Research Context:

2.1. Choreographic research and Access Grid

Despite numerous attempts to use Internet communications for distributed dance-making processes, point-to-point communications have proved more suited to the transmission of high-quality video telematics for performance (Popat 2006, Dinkla and Leeker 2005). Yet these cannot support the broader networks for collaborative choreography that the AG can offer (Sermon 2006).

Little research has been undertaken into the implications of AG and associated technologies for dance. This project builds on the work of a few pioneering researchers. *Dancing Beyond Boundaries* (Super Computing Global (SCG) conference, 2001) linked performers in locations across the USA. The choreography explored limitations inherent in the video and its display windows, using framing effects and the image degradation associated with fast movement. Kelli Dipple's multiple-site panel *Navigating Gravity: Remote Collaboration and Infrastructure* (SCG Conference 2003) used AG to

challenge perceptions of performative space. She employed combinations of real-time and pre-recorded material, moving windows into asymmetrical alignments and changing backgrounds, exploring how multiple video windows fragmented narrative relationships. Jimmy and Beth Miklavcic's *Interplay: Loose Minds in a Box* (SCG Conference 2005) linked six AG nodes and further explored the distribution of performers; however the performance was still created to be viewed from one location and a single directorial position. Helen Bailey and Martin Turner's *Stereo-bodies: Improvisation and Choreography within the AG* (VRE CSAGE project 2006) explored the Grid as both a compositional and performative space, challenging the notion of a single performance location, integrating stereoscopic video technology to fracture the 2D/3D visual frame. Multi-disciplinary improvisations at the *Locating Grid Technologies* Workshop Scheme (University of Bristol, 2006) revisited elements of previous works, playing with arrangements of video windows and acknowledging multiple performance locations.

While these projects began to question the AG interface for performance, none explore the full extent of the AG as a communications medium for choreographic research *processes*.

A clear space emerges for this project as it seeks to facilitate and interrogate distributed choreographic processes with a democratic collaborative approach to choreography.

2.2. Documenting choreographic practice with e-Science technologies
'The Grid' and 'e-Science' were driven initially by requirements for an infrastructure to deliver distributed computation and storage. As this infrastructure stabilises, a logical development has been to overlay the Semantic Web paradigm, contextualised to conceive the Semantic Grid (Sure and De Roure, 2006), as a means of adding a more abstract layer of interoperable, machine-readable descriptions of Grid resources. Social science and user-centred computing perspectives have broadened the e-Science scope, firstly covering more of the formal activities that constitute scientific practice, and secondly illuminating the social processes and work practices that constitute 'collaborative scientific practice', which must be designed for in socio-technical systems.

Attention has focused on how different kinds of technology can build on the Grid infrastructure to support these intrinsically human activities. A key requirement has been to develop communication channels that are as transparent as possible. Consequently, the most established of the current generation of tools seek to minimise the structure that they impose on communication (but with associated limitations):

- **Audio-video communication**: As a high-quality Internet videoconferencing medium, the AG seeks transparency as a substitute for physical meetings (but 'knows' nothing about what happened in the meeting)

- **Textual communication**: Email, instant messaging and threaded web discussion forums mediate textual exchanges of ideas (but provide little support for quick visual appraisal of the status of a conversation as it grows in size and complexity)

- **Textual annotation**: 'Folksonomic' tagging schemes provide shared web bookmarking (but no support for understanding higher level patterns such as relationships between tags, moving from indexing to deeper interpretation and knowledge construction).

A combination of the above would deliver a rudimentary toolset for distributed choreographic research, but with the associated design limitations for supporting real-time capture of 'choreographic memory' as proposed here.

In particular, science has an interest in 'sensemaking', an interpretive activity described by Weick (1995),

> *Sensemaking is about such things as placement of items into frameworks, comprehending, redressing surprise, constructing meaning, interacting in pursuit of mutual understanding, and patterning.* (Weick, 1995, p.6)

Like Weick, our concern is with 'the making of sense': using our bodies and media to make interpretations of a situation tangible, sustaining the dialogue with ourselves, and engaging others. This characterises much interpretive, creative, narrative activity, including the choreographic process.

Embodied, multimedia sensemaking thus drives this project's challenge to deploy and refine e-Science sensemaking tools to augment both the choreographic process and broader practice-led arts research. The e-Science search for tangibility chimes with the long-running debate concerning documentation of practice-led arts research. The embodied non-verbal status of dance provides the most extreme context for these issues. Beyond graphic notation systems, documentation to date has largely relied on video and writing. Bailey (2000, 2003) and Popat (2006) have investigated methods including non-linear, poly-vocal writing and online documentation tools. Other researchers have used digital technologies for documentation, but this project will be the first to appropriate and repurpose e-Science tools. It builds on the success that co-investigators have had in the JISC Memetic project, addressing this challenge in an e-Science/VRE context. Memetic has shed light on the socio-technical dimensions to the design of practical tools that help move significant sensemaking activities from being ephemeral moments that are hard to reconstruct, to create digital memory traces that can be archived, interrogated and reused in flexible ways.

For meetings, video from AG 'fills in the gaps' that terser concept maps cannot express; conversely, concept maps provide semantic indexing within/across meetings, enabling users to jump to the point in a meeting, for instance, when an argument was made (Buckingham Shum, et al. 2006).

Implications for documentation of arts practice are evident in the preservation, notation, and instant access of key annotated moments of the creative process. The development of e-Science tools for dance research purposes could require radical re-evaluation of data-gathering and analysis techniques. The distributed creative environment requires a paradigmatic shift in thinking and methodology in order to fully align the technological and artistic possibilities of the AG.

3. Research Methods:

The project is cross-disciplinary and collaborative, bringing together an experienced team of researchers in the fields of e-Science and dance/technology. Two Research Assistants will support the e-Science Co-Investigators. Five professional dance practitioners will work alongside the dance researchers, challenging the technologies with high-level performance skills and choreographic understanding. A Technical Assistant will provide support during the research intensive periods, stakeholder workshops and symposium/performance event.

3.1. Research Activities

The central activities will be five intensive practice-led dance research periods that will be used to inform development of e-Science tools (the 'Project Timetable' attachment provides scheduling information):

Year 1: September 2007 to August 2008

Year 1 will focus on three 2-week intensive studio-based research periods, involving professional dance practitioners in multiple locations working alongside the researchers via AG. Each research intensive will address specific themes:

Research Intensive 1 (2 weeks Jan. 2008) - **Relocating Choreographic Practice:** Explorations of the improvisational, compositional and performative challenges of the distributed AG environment for dance.

Research Intensive 2 (2 weeks April 2008) - **Mapping, Memory and Narrative:** Impact of e-Science tools on documenting the creative research process for dance.

Research Intensive 3 (2 weeks July 2008) - **Traces and Reiterations:** Re-use and mediation of documentation material in hybrid AG dance performance.

Year 2: September to August 2009

In Year 2, two longer intensive research periods provide more sustained investigations of choreographic process and documentation in the distributed environment. These will test new developments and prototypes made by the e-Science researchers and new creative methodologies by dance

researchers, developed and consolidated between July and October 2008.

Research Intensive 4 (March - April 09) - **Distributed Choreographic Laboratory**
Dancer-collaborators working in individual, distributed contexts will explore developmental compositional tasks constructed by the choreographic research team in response to Year 1. Over a period of 5 months on a 'drip-feed' basis of one-day per week, they will document their creative processes using an extended developmental version of the 'Portable Video Mapping Studio' (see 'Software Deliverables').

Access Grid Sharings:
Regular AG meetings will enable dancers, choreographic researchers and e-scientists to share findings and experiences, exploring AG as a distributed choreographic laboratory and testing the 'Choreographic Planning Tool' (see 'Software Deliverables'). Dancers' individual annotated documentary video material will be uploaded, instigating choreographic and performative responses. These sharings will be annotated as a further layer of documentation of the development of ideas/discourse/knowledge.

Reflection:
Period of consolidation to review documentation methods and material, and the role of e-Science technologies in the documentation process. Creative re-use of material in performance will be planned as a critical exploration of narrative and memory in process. Visual interfaces will be re-developed to support this if necessary.

Research Intensive 5 (June 09) - **Distributed Process and Performance**
This final intensive distributed studio-based period will allow materials generated and documented in the various stages to be consolidated and re-deployed, exploring the 'User Interface to Support the Performance Process' and 'Support for Memory Input into Performances' (see 'Software Deliverables'). The choreographic researchers will explore the newly-developed range of compositional methods in a distributed, multi-site performance event, integrating live and pre-recorded materials and exploring the manipulation and mediation of documentary material. This event will be staged within a final symposium, open to stakeholders, e-scientists, and academic and professional arts communities.

Five stakeholder workshop/seminars, held at the end points of each Research Intensive, will investigate user requirements for the e-Science technology and feedback on functionality and usability as well as engage with the practice-led research themes. Workshop/seminars will be open to invited stakeholders including arts, humanities and e-Science researchers.

3.2 Software Development

The Research Intensives provide a test-bed and stimulus for developments within e-Science tools to meet artists' needs for:

- Performance in a cinematic AG context;
- Documentation of the choreographic process;
- Dissemination of research.

Examples of these developments include: support for enhanced video features within the AG; flexible and powerful video annotation for performers; choreographic planning support; rich, multi-level annotation capture; editing/conversion software to allow AG recordings to be presented in common media formats; and an interface to data Grid technology. A full list of these deliverables can be found in the Technical Appendix and full descriptions are available as an attached document 'Software Deliverables'.

4. Project Management:

4.1. Management structure/roles

The project will be managed and administrated through a Project Management Group (PMG).

The PMG will:

- meet monthly (by AG) to discuss progress against milestones and remedial action if required;
- submit a six-monthly report to the AHRC outlining achievements and progress;
- report to the Project Steering Group, comprising project stakeholders, subject discipline specialists, and University of Bedfordshire representatives, who will be invited to oversee the project and ensure continuity of expertise.

The Principal Investigator will be responsible for the management of the overall research direction of the project. Research activities will be undertaken through a series of Work Packages, led and managed by the Co-Investigators. All members of the team will contribute ideas and develop methodological approaches, evaluate research activities and present research outcomes. Three 'Project Sandpits' will provide informal settings in which to extend speculative thinking, reflect on and review aspects of the project, and develop and consolidate collaborative working relationships.

The project team comprises:

Principal Investigator:	Helen Bailey (Department of Performing Arts and English, University of Bedfordshire)
Co-Investigators:	Simon Buckingham Shum (Knowledge Media Institute, Open University) Michael Daw (Manchester Computing/Access Grid Support Centre, University of Manchester), Sita Popat (School of Performance & Cultural Industries, University of Leeds).

Team members have experience of managing multi-disciplinary research projects on this scale.

Bailey and Popat have established dance/technology research portfolios, investigating choreographic collaboration via digital and communications technologies. Daw's Collaborative Technologies group at Manchester Computing supports the UK AG user community. He has collaborated with Kelli Dipple on AG performances. Daw works closely with Dr Martin Turner, (Manchester Visualization Research Group, University of Manchester), who collaborated on AG dance projects with Bailey. Daw and Buckingham Shum have collaborated since 2004 on the JISC VRE Memetic project, which forms the core enabling technology in this proposal. The Open University leads the software development of the Compendium concept-mapping tool, which has an international, highly active user community, while Buckingham Shum is a leading researcher in Design Rationale (approaches to capturing reasoning in design processes) and Scholarly Hypermedia (applications of hypermedia to research processes).

4.2. Project Timetable/Costs

See 'Project Timetable' in 'Attachments'. The structure of activities takes account of the distributed and collaborative nature of the research, reflecting the demands of the methodologies to be employed. Regular consultation with stakeholders through workshops will ensure continued relevance of activities and direction.

The project use of Grid technologies will provide cost effective means by which collaborative research can be undertaken nationally and internationally. Dissemination in a variety of formats appropriate to both e-Science and dance research will enable broad impact and ensure value for money.

5. Dissemination and Knowledge Transfer

The project will provide the following public outputs:

- Enhanced software tools for the practice-led researcher
- 4 stakeholder workshops
- 4 refereed conference presentations
- 1 distributed live/AG hybrid performance event
- 1 international symposium
- 4 co-authored journal articles

Publicly available on-line resources:

- Edited documentary of the various practice-led research stages of the project
- Non-linear documented record of process and performance
- Website, wiki and blogs

Conference presentations and journal articles will be permutated from the following themes:

- Impact of Grid technologies on choreographic process
- Use of Grid technologies to document practice-led research in the arts
- Impact of Choreographic knowledge on Grid technology design
- Interdisciplinary collaborative research practice

Conferences/journals to be targeted (indicative):

- ISEA, DRHA, Performance Studies International, Computer Supported Cooperative Work, Super Computing Global Conference.
- Performance Research Journal, Leonardo, International Journal of Performance Arts and Digital Media.

Outputs together with the project website, the AHeSSC website and JISC-mail groups will impact upon a wide constituency including arts, humanities and e-Science researchers, the broader academic and professional arts communities.